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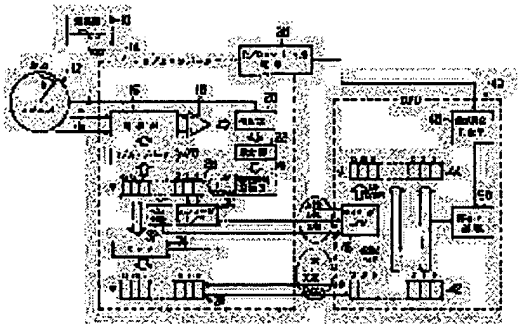
(54) ROTATION ANGLE DETECTING EQUIPMENT OF ROTARY MACHINE

(57)Abstract:
PROBLEM TO BE SOLVED: To enable rotation angle data to be calculated when the voltage of a power source of an R/D converter calculating rotation angle data from a resolver output once decreases to be lower than a specified value and then has returned to the specified value.
SOLUTION: An R/D(resolver/digital) converter 14 outputs an A-phase signal showing normal rotation of a rotary machine and a B-phase signal showing inverse rotation. The R/D converter 14 outputs data ϕ showing the rotation angle itself (absolute value). On the basis of the A-phase signal and the B-phase signal, a CPU 40 calculates a rotation angle as data Ψ, and controls the rotary machine on the basis of the data Ψ. After the voltage of a power source 38 for the R/D converter decreases lower than a specified value and then returns to a voltage higher than or equal to the specified value, the CPU reads the data ϕ of the absolute valu of the rotation angle, resets the data as the initial value of the data Ψ. Aft r that, similarly to the normal case, the data Ψ are calculated on the basis of the A-phase signal and the B-phase signal, and the rotary machine is controlled.



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CLAIMS

[Claim(s)]
[Claim 1] Angle-of-rotation detection equipment of a rotating machine characterized by providing the following A resolver which outputs a signal according to an angle of rotation of a rotating machine The increase and decrease of a signal which shows whether an angle of rotation carried out the increment in a predetermined angle, or it decreased based on an output signal of said resolver A R/D converter which outputs a signal which shows an absolute value of an angle of rotation A means direct to compute an angle of rotation of a rotating machine by reading an absolute value of said angle of rotation as initial value, supervising voltage of a means to compute an angle of rotation of a rotating machine by accumulating said increase and decrease of a signal henceforth, and a power supply of said R/D converter, returning more than predetermined voltage after voltage turns into under predetermined voltage, reading an absolute value of said angle of rotation after after [returns of failed voltage] predetermined time progress, and accumulating said increase and decrease of a signal henceforth

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] This invention relates to the equipment which detects the angle of rotation of rotating machines, such as a motor, using a resolver.
[0002]
[Description of the Prior Art] The resolver which detects the angle of rotation of Rota of a rotating machine is known. The angle of rotation detected by the resolver is used for control of the current of the rotating machine concerned etc. If the signal of a sine wave sinomegat is inputted into the primary coil of a resolver, signal sinomegatsintheta modulated according to the motor angle of rotation theta, respectively and sinomegatcostheta will be obtained by two secondary coils arranged with 90-degree phase contrast. A R/D converter (a resolver / digital converter) computes an angle of rotation theta based on the aforementioned resolver output, and outputs this. What outputs especially the both sides of the signal which shows whether an angle of rotation theta is increasing (under normal rotation) and whether it is under reduction (under an inversion), and the signal which shows angle-of-rotation theta itself in a certain kind of R/D converter is known. When using the former output, the angle of rotation theta is computed by only said predetermined angle increasing or decreasing an angle of rotation theta, whenever it carries out predetermined angle rotation. What is necessary is just to use the value of this output as an angle of rotation theta as it is, since the value itself which an output shows shows the value of the absolute angle of rotation theta when using the latter output.
[0003]
[Problem(s) to be Solved by the Invention] When using the signal which shows the value (it is hereafter described as an absolute value) of the latter (i.e., the angle of rotation itself) as an angle of rotation used for control of a rotating machine, the burden of CPU for rotating-machine control (central processing unit) becomes large. In order to mitigate the burden of CPU, the angle of rotation theta which accumulated and presumed the angle-of-rotation change from a reference value by the former, i.e., the signal which shows the information on the change in an angle of rotation, may be used. However, in this method, since the information only on change of an angle of rotation was used, when the supply voltage of a R/D converter became under a predetermined value, also when it recovered after that beyond a predetermined value, of course, there was a problem that an angle of rotation was uncomputable. That is, since the signal of angle-of-rotation change was not outputted or a random thing was outputted while supply voltage is under a predetermined value, the problem that a gap arose was in the computed angle of rotation and the actual angle of rotation.

[0004] Moreover, this invention aims at offering the equipment which can compute an angle of rotation, also when the voltage of the power supply for R/D converters once falls under to normal voltage and returns after that.
[0005]
[Means for Solving the Problem] In order to solve the above-mentioned technical problem, angle-of-rotation detection equipment of a rotating machine concerning this invention A resolver which outputs a signal according to an angle of rotation of a rotating machine, and the increase and decrease of signal which shows whether an angle of rotation carried out the increment in a predetermined angle, or it decreased based on an output signal of said resolver A R/D converter which outputs a signal which shows an absolute value of an angle of rotation, and a means to compute an angle of rotation of a rotating machine by reading an absolute value of said angle of rotation as initial value, and accumulating said increase and decrease of a signal henceforth, Voltage of a power supply of said R/D converter is supervised, after voltage turns into under predetermined voltage, it returns more than predetermined voltage, and it has a means to direct to compute an angle of rotation of a rotating machine after after [returns of failed voltage] predetermined time progress by reading an absolute value of said angle of rotation, and accumulating said increase and decrease of a signal

henceforth.
[0006] After voltage returns to normal voltage, an absolute value of an angle of rotation is read and let this be initial value. By this, an angle of rotation can be computed by the ability to accumulate a change in an angle of rotation henceforth.
[0007]
[Embodiment of the Invention] Hereafter, the gestalt (henceforth an operation gestalt) of operation of this invention is explained according to a drawing. The outline configuration of the equipment of this operation gestalt is shown in drawing 1 . An oscillator 10 outputs a reference sign sinomegat and this is impressed to the primary coil of a resolver 12. Voltage sinomegatsintheta by which the reference sign was modulated by the angle of rotation theta of rotating machines, such as a motor, and sinomegatcostheta occur in two secondary coils arranged with the 90-degree phase contrast of a resolver 12, and these are outputted to them as a resolver signal. In addition, in processing of a resolver signal, since only a phase poses a problem, said reference sign and a resolver signal explain the amplitude as 1.
[0008] It is sent to the R/D converter 14 and a resolver signal is each with a multiplier 16. The multiplication of cosphi and sinphi is carried out, it subtracts with a subtractor 18, and sinomegatsin (theta-phi) is obtained. About phase contrast phi, it mentions later. This signal and reference sign sinomegat are inputted into a wave detector 20, and a wave detector 20 outputs only the modulation component sin (theta-phi). If an integrator 22 integrates with the output sin (theta-phi) of a wave detector 20 and this value exceeds a positive predetermined value, a voltage controlled oscillator 24 will perform the directions to which the value of phase contrast phi is made to increase. Moreover, the directions with which a voltage controlled oscillator 24 decreases the value of phase contrast phi as the output of an integrator 22 is under a negative predetermined value with said equal positive predetermined value and positive absolute value are performed.
[0009] The value of 12-bit rise / down counter 26 increases and decreases with the increment in a voltage controlled oscillator 24, and reduction directions. The value stored in this counter 26 expresses phase contrast phi, this phase contrast phi is inputted into a multiplier 16 through D/A converter (digital/analog converter) 28, and the above-mentioned operation is performed.
[0010] They repeat an operation until it forms a feedback circuit and a phase (theta-phi) is set to 0 (i.e., until counted value phi of a D/A converter [the above circuit 16, i.e., a multiplier, to / a subtractor 18, a wave detector 20, an integrator 22, a voltage controlled oscillator 24, a counter 26, and D/A converter 28] of an angle of rotation theta and a counter 26 corresponds). Therefore, after being completed by feedback, counted value phi of a counter 26 expresses an angle of rotation theta. In addition, in the case of this operation gestalt, the time amount which convergence of this counter value phi takes is about 1ms.
[0011] Based on the output of 2 bits of the low order of a counter 26, encoder I/F (encoder interface) outputs the A phase signal and B phase signal showing the hand of cut of a rotating machine. Mutually, a phase is the square wave signal shifted 90 degrees, these phase signals show that the rotating machine is rotating normally, when the phase of an A phase is progressing, and when the B phase is progressing to reverse, they show that it has reversed. Whenever the counter value phi is counted up or downed, an A phase and a B phase signal are outputted.
[0012] The output of all the bits of a counter 26 is sent to the zero judging section 32, and the signal with which it shows Z phase from this zero judging section 32 when it is judged here that the counter 26 became zero is outputted. This Z phase signal is outputted once per rotation of a rotating machine.
[0013] On the other hand, if the latch signal CS is received from CPU40 for rotating-machine control mentioned later, a latch circuit 34 latches the value phi of the counter 26 at this time, and stores in serial I/F (serial interface) 36. And according to the clock signal CLK from CPU40, data is outputted from serial I/F 36.
[0014] The above R/D converter 14 is driven with the power from the power supply 38 for R/D converters.
[0015] CPU40 for rotating-machine control stores the output from serial I/F 36 in the absolute value data storage section 42. The stored data is the counter value phi when latch directions are made, and this expresses the angle of rotation theta. If it is at the time of starting of a rotating machine, the data phi of the absolute value data storage section 42 is further transmitted to the data storage section 44 for control, and this serves as initial value of the data psi of the angle of rotation for control. Read-out of the data from serial I/F 36 is performed every 2ms in this operation gestalt, and the data stored in the absolute value data storage section 42 is updated at this time.
[0016] On the other hand, encoder I/F46 of the carrier beam CPU 40 increases, decreases the value of the data psi in which it was stored by the data storage section 44 for control based on the A phase and the phase of a B phase signal, and updates an A phase, an above-mentioned B phase signal, and the above-mentioned North marker. That is, if the A phase is progressing to the B phase, Data psi will be made to increase, and Data psi will be decreased if the B phase is progressing to reverse. Moreover, if Z phase signal is detected, the data storage section for control will be cleared and Data psi will be set to 0. If each part functions normally, the angle-of-rotation data psi for counted value [of a counter

26] phi and control is substantially in agreement with the actual angle of rotation theta. And CPU40 controls the phase current of a rotating machine based on this data psi.
[0017] Thus, in this operation gestalt, if only initial value is read from serial I/F 36, an angle of rotation theta (= data psi) is henceforth computable only with the output of encoder I/F30 and the zero judging section 32. However, once the data psi stored in the data storage section 44 for control by a certain cause shifts from the actual angle of rotation theta, this gap will not be corrected until Z phase signal is received. For example, after the voltage of the power supply 38 for R/D converters becomes under the voltage on which this converter operates normally, even if voltage returns to normal values, the data psi of an angle of rotation shifts from the actual angle of rotation theta. This is for a gap to arise and for this gap not to cancel after returns of failed voltage by not outputting an A phase and a B phase signal at the time of sag, or outputting a random value.
[0018] It may happen enough that the voltage which once fell returns in the battery for auxiliary machinery carried in the automobile. That is, when the controlled system of this operation gestalt is the motor carried in the hybrid car which is a kind of an electric vehicle, a generation of electrical energy is made with the output of the engine carried in the hybrid car concerned, charge is made by said auxiliary machinery battery after this, and voltage may return to normal values. Thus, that the voltage of the power supply for R/D converters once falls, and returns after that is an event assumed enough.
[0019] When the above failures arise, in order to detect this, the powerfail judging section 48 and the re-set processing section 50 are formed in this operation gestalt. That is, it judges whether CPU40 has the voltage of the power supply 38 for R/D converters in the range of voltage in which the R/D converter 14 operates normally. The range of this voltage is the fixed value usually set up beforehand. When the voltage of a power supply 38 is no longer the aforementioned voltage range (i.e., when it falls under to a predetermined voltage value), halt control of the rotating machine is carried out. At this time, if it is a hybrid car, it will run only with an engine. If the abnormalities of a power supply 38 are canceled (i.e., if voltage is recovered beyond a predetermined voltage value), re-set processing in which the data phi stored in the absolute value data storage section 42 is transmitted to the data storage section 44 for control will be made. As mentioned above, since the data phi of an absolute value comes to express an angle of rotation theta in about 1ms, if re-set processing of the after that above-mentioned is performed, Data psi will express an angle of rotation theta. In consideration of this time lag, the re-set of Data psi is performed after predetermined time progress. And after this, based on the A phase and B phase signal which are the output of encoder I/F30, and Z phase signal, calculation of the angle-of-rotation data psi is performed like the usual control, and control of a rotating machine is performed based on this.
[0020] The voltage of a power supply 38 falls to drawing 2 , and the appearance of the data phi and psi showing the angle of rotation when returning after that is shown in it. If the voltage of a power supply 38 falls, an A phase and a B phase signal will become unfixed, and the angle-of-rotation data psi used for control will become unfixed (the time of day t1 or subsequent ones). Moreover, the absolute value data phi serves as an indeterminate. When supply voltage is recovered (time of day t2), it converges by the above-mentioned feedback operation, and the absolute value data phi comes to express an angle of rotation theta. On the other hand, a certain deflection produces Data psi with the actual angle of rotation theta. The absolute value data phi is read as data psi for control by re-set processing after predetermined time progress (time of day t3), and deflection with an angle of rotation theta is solved henceforth.
[0021] The flow chart about the re-set of the data psi for control of a rotating machine after the power supply return of this operation gestalt is shown in drawing 3 . This processing is performed periodically. It is judged whether the voltage of the power supply 38 for R/D converters is beyond a predetermined value (S100), if it is under a predetermined value, an abnormality judging will be made and the delay counter Td about a power supply return will be set to a predetermined value (S102). The delay counter Td is for performing re-set processing after a power supply return and predetermined time progress, and the delay counter Td is subtracted, and when set to 0, re-set processing is made so that it may mention later. At step S102, after the power supply return counter Td is set, it escapes from this flow and this flow is again performed after predetermined time.
[0022] Since predetermined time if, i.e., it is judged whether the delay counter Td is 0, and it is judged that it is normal and it is not 0, until the voltage of a power supply 38 will still perform re-set processing at step S100 has not passed, it escapes from this flow. [predetermined] [beyond] On the other hand, if the delay counter Td is judged not to be 0 at step S104, the decrement of the delay counter Td will be performed (S106). If it is not 0, since 0 is judged for the delay counter Td after a decrement, and predetermined time will not have passed, it escapes from this flow. If it is 0, the data phi of the absolute value data storage section 42 will be transmitted to the data storage section 44 for control, and re-set processing which makes this the angle-of-rotation data psi for control will be performed (S110).
[0023] Thus, if a power supply returns normally, only when a decrement, i.e., sequential subtraction, is made and the

delay counter Td is set to 0 at the beginning after a power supply return, as for the delay counter Td set up when the voltage of a power supply 38 became abnormalities, re-set processing will be performed.
[0024] As mentioned above, a rotating machine is controllable by performing again the initial set of the data psi of the angle of rotation currently computed as an accumulation value based on the increase and decrease of information of an angle of rotation by the absolute value data phi of an angle of rotation after predetermined time progress, after the voltage of the power supply 38 for R/D converters once falls and returns after that again after a return.

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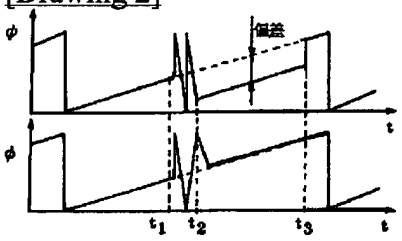
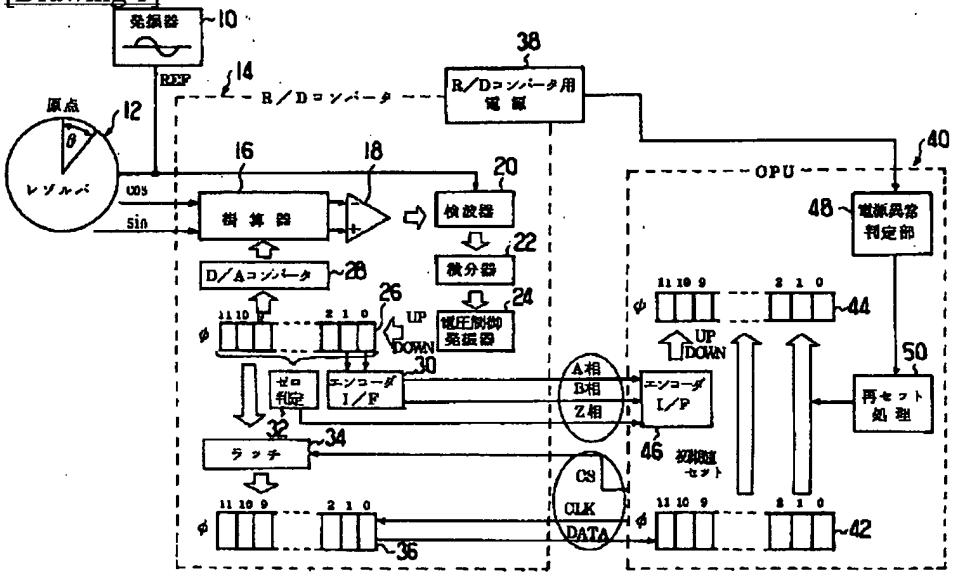
DRAWINGS

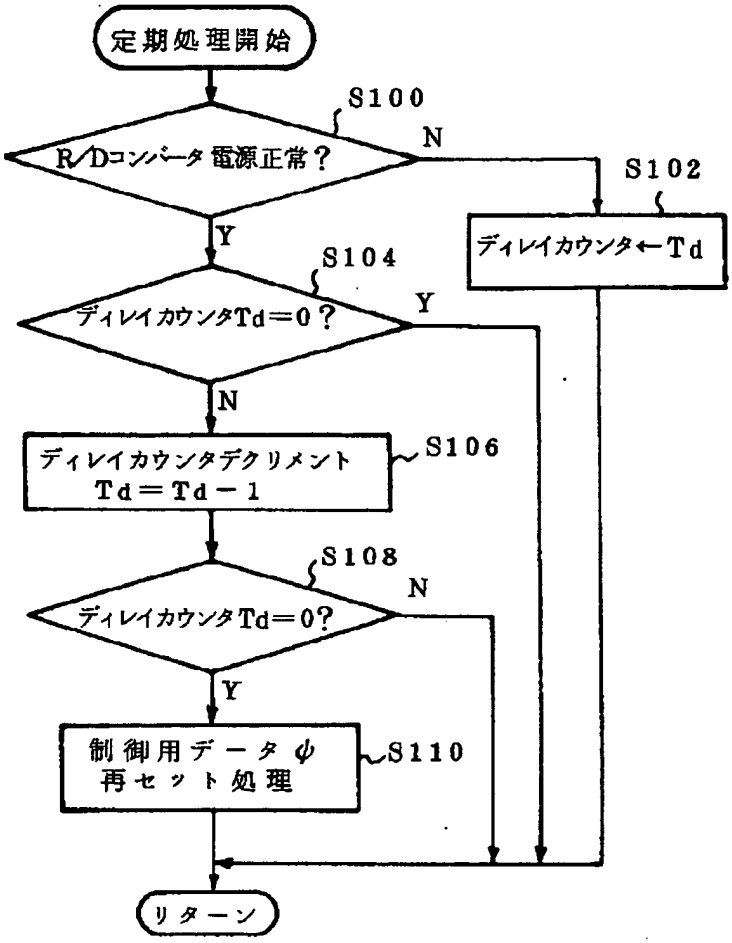
[Drawing 2]



[Drawing 1]



[Drawing 3]



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